Final Project Summary

Project title	Control of ramularia leaf spot in a changing climate (CORACLE)		
Project number	RD-2007-3441	**Final Project Report**	PR553
Start date	April 2009	**End date**	March 2014
AHDB Cereals & Oilseeds funding	£200,000	**Total cost**	£910,000

What was the challenge/demand for the work?

Ramularia (*Ramularia collo-cygni*) had become an established barley disease in the north of Europe and the disease had been active in Scotland since 1998 and was spreading further south. Yield impacts were significant in some years. Research had shown seed infection was a key method of spreading the disease within a season and potentially into new areas via seed movement. Spore dispersal patterns had shown the pathogen to be closely linked to the barley crop and this suggested alternative hosts did not play an important part in disease development. However a second spore type was known, demonstrating a lack of understanding about the pathogen. Very little was known about varietal resistance.

How did the project address this?

The research worked on four interlinked solutions to managing the disease 1) refinement of a risk forecast based on lower risk areas of England compared to high risk regions in the north of the UK, 2) the role of seed infection in the spread of disease, 3) the scope for breeding for resistance and 4) establishing a fundamental understanding of the pathogen.

What outputs has the project delivered?

CORACLE established that Ramularia epidemics can be predicted from leaf surface wetness during the period of stem extension, normally in May or June for spring barley allowing a disease forecasting system to be developed.

Current chemical seed treatments are ineffective at reducing levels of *R. collo-cygni* in seed. Hot water treatment can reduce levels of ramularia DNA in seed, but this does not necessarily translate to lower disease levels.

The fungus is genetically diverse and is closely related to *Zymoseptoria tritici* which casuses septoria leaf blotch in wheat.

Good genetic resistance to Ramularia in diverse varieties of both winter and spring barley.

It was discovered that the *mlo* gene, which controls powdery mildew in many spring barley varieties, substantially increases susceptibility to Ramularia.

However, some *mlo* varieties have higher levels of resistance to ramularia than others indicating it is possible to select for improved Ramularia-resistance in mlo varieties.

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Physical stress plays a central role in the transition from a harmless symptomless infection to symptoms associated with yield loss. Varieties which are better able to tolerate physical stress are generally less susceptible to Ramularia.

Who will benefit from this project and why?
Farmers in Scotland have access to an annual Ramularia risk forecast Breeders have a greater understanding of the genetic basis of resistance to Ramularia allowing development of new varieties with greater Ramularia resistance Awareness of the disease has been raised allowing farmers and agronomists to identify and appropriately treat epidemics, reducing potential yield loss.

If the challenge has not been specifically met, state why and how this could be overcome
Further development of the risk forecast is continuing, with AHDB weather stations being used to extend the forecast to England. Ramularia resistance ratings have been added to the barley Recommended List allowing farmers to select more resistant varieties. This should encourage breeders to make use of the new genetic knowledge to breed more resistant varieties.

Lead partner	James Brown, John Innes Centre
Scientific partners	The Arable Group (NIAB) Scottish Agricultural College (SRUC) Scottish Crop Research Institute
Industry partners	BASF Bayer Crop Science KWS UK LS Plant Breeding Masstock Arable (UK) Limagrain UK Saaten Union (UK) Sejet SW Seed Syngenta Seeds
Government sponsor	Defra